Arboviruses on the Horizon

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Arboviruses

- "Arboviruses" = arthropod-borne viruses
- Arboviruses are vectored by mosquitoes, ticks, sandflies, biting midges, etc.
- Focus on mosquito-borne viruses that are NOT currently in the U.S., but which pose the greatest threat for future introduction.

Mosquito-miscellaneous

- 3,000+ mosquito sp. – worldwide
- Small % of species are competent vectors.
- Mosquitoes get moved around frequently as adults or as eggs.
- 100+ arboviruses that are currently known to be pathogenic to humans. Most are mosquito-borne.
- Three major Families of Arboviruses

Mosquito-Borne Arboviruses
Family Flaviviridae / *Flaviruses*

- Banzi
- Bussuquara
- Dengue 1,2,3,4
- Edge Hill
- Ilheus
- Japanese Enceph.
- Kokobera
- Kunjin
- Murray Valley
- Rocio
- Sepik
- Spondweni
- Usutu
- Wesselbron
- West Nile virus
- Yellow Fever
- Zika

Mosquito-Borne Arboviruses
Family Togaviridae / *Alphavirus*

- *Barmah Forest*
- *Chikungunya*
- *Mayaro*
- *O'nyong-nyong*
- *Ross River*
- *Semliki Forest*
- *Sinbis*
- *VEE*

- *List does not include arboviruses currently existing in the U.S.*

Mosquito-Borne Arboviruses
Family Bunyaviridae

- Apeu
- Caraparu
- Itaqui
- Madrid
- Marituba
- Murutucu
- Nepuyo
- Oriboca
- Ossa
- Restan
- Bunyamwera
- Germiston
- Tensaw
- Bwamba
- Guaroa
- Snowshoe hare
- Tahyna (Lumbo)
- Catu
- Guama
- Rift Valley Fever

Arboviral Clinical Syndromes

- Acute CNS illness – aseptic meningitis and/or encephalitis
- Acute benign fevers (with or without exanthem)- usually self limiting
- Hemorrhagic fevers – acute febrile illness, capillary leakage, extensive hemorrhage, shock, liver damage
- Polyarthritis & Rash – arthrlagias of varying duration

Arboviruses on the Horizon

- Less than 10 years ago, West Nile virus (WNV) was "on the horizon."
- WNV – serves as an example of what can happen when a new virus is introduced into a different ecology and into naïve populations.
- WNV was a wake-up call for PH.
- "West Nile virus is not the first arbovirus to enter the U.S., and it won't be the last." L. Peterson, CDC

Oh, what short memories we have..

- WNV response – dramatic ↑ programs.
- WNV is not going away.
- WNV is considered "old news."
- Federal & local funding is declining↓
- Surveillance / vector control programs are being dismantled across the country.
- "Those who fail to learn from the past, are destined to repeat it."

Factors that increase the odds for the introduction of new arboviruses

- Animals, birds, arthropods & pathogens are being moved around the globe by natural means or human intervention.
- International travel
- International trade
- Climate change / global warming
- Ongoing/expanding arboviral disease outbreaks
- Pathogen – changes at molecular level
- Declining infastructure to detect & respond

Chikungunya

- Togaviridae, Genus *Alphavirus*
- Principal vectors = *Aedes aegypti* & *Ae. albopictus*
- Reservoir = humans – infection can result in very high viremias (>10^8 copies/ml plasma) before & during early illness.
- Makonde word meaning "bent / contorted" – referring to the stooped postures of patients – due to severe joint pain.
- First described in 1955 following outbreaks on the Makonde Plateau between Mozambique & Tanganyika.

Chikungunya Symptoms

- Similar to dengue
- Sudden onset of fever
- Severe arthralgia (joint pain) & myalgia (muscle pain) resulting in stooped posture
- Maculopapular rash
- Headache, fatigue, nausea
- Long lasting disability due to persistent arthralgia -"crippling pain"

Chikungunya: Recent Events

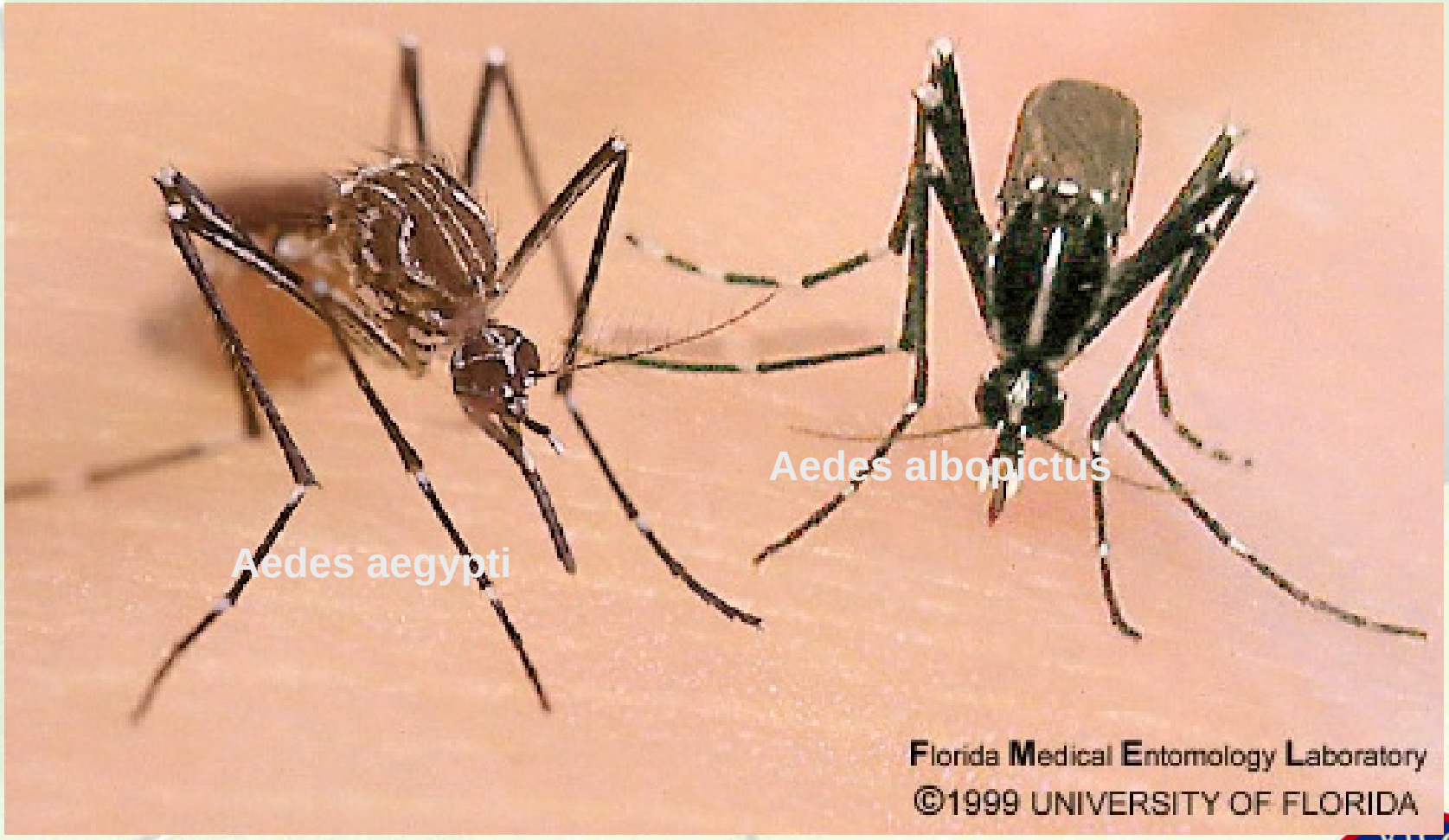
- Indian Ocean Region – Seychelles, Mauritius, Comoros, Re'union – favorite tourist destinations for Europeans
- Reunion Island – 2006 – 266,000 cases (35% of population)
- India – 2006 - 1.39 million cases
- 2007 – spread to Malaysia & Indonesia
- European travelers – France, Germany, Italy, etc. – imported cases↑ (e.g. 800 cases in France).
- Outbreak in Italy 2007 – local transmission via *Ae. albopictus* mosquitoes. 200+ cases reported.
- 38 imported cases → U.S.

Western Indian Ocean

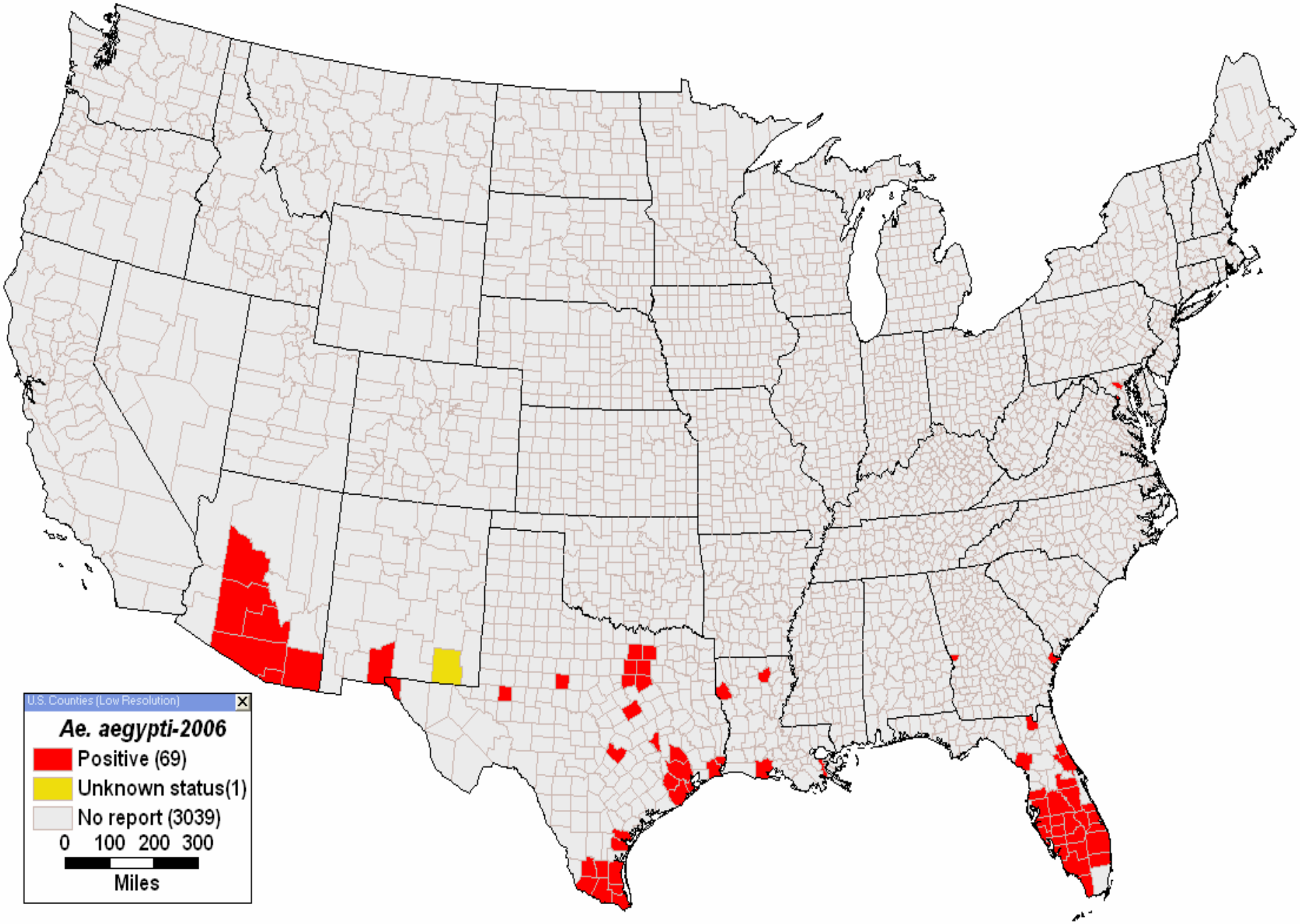
Chikungunya

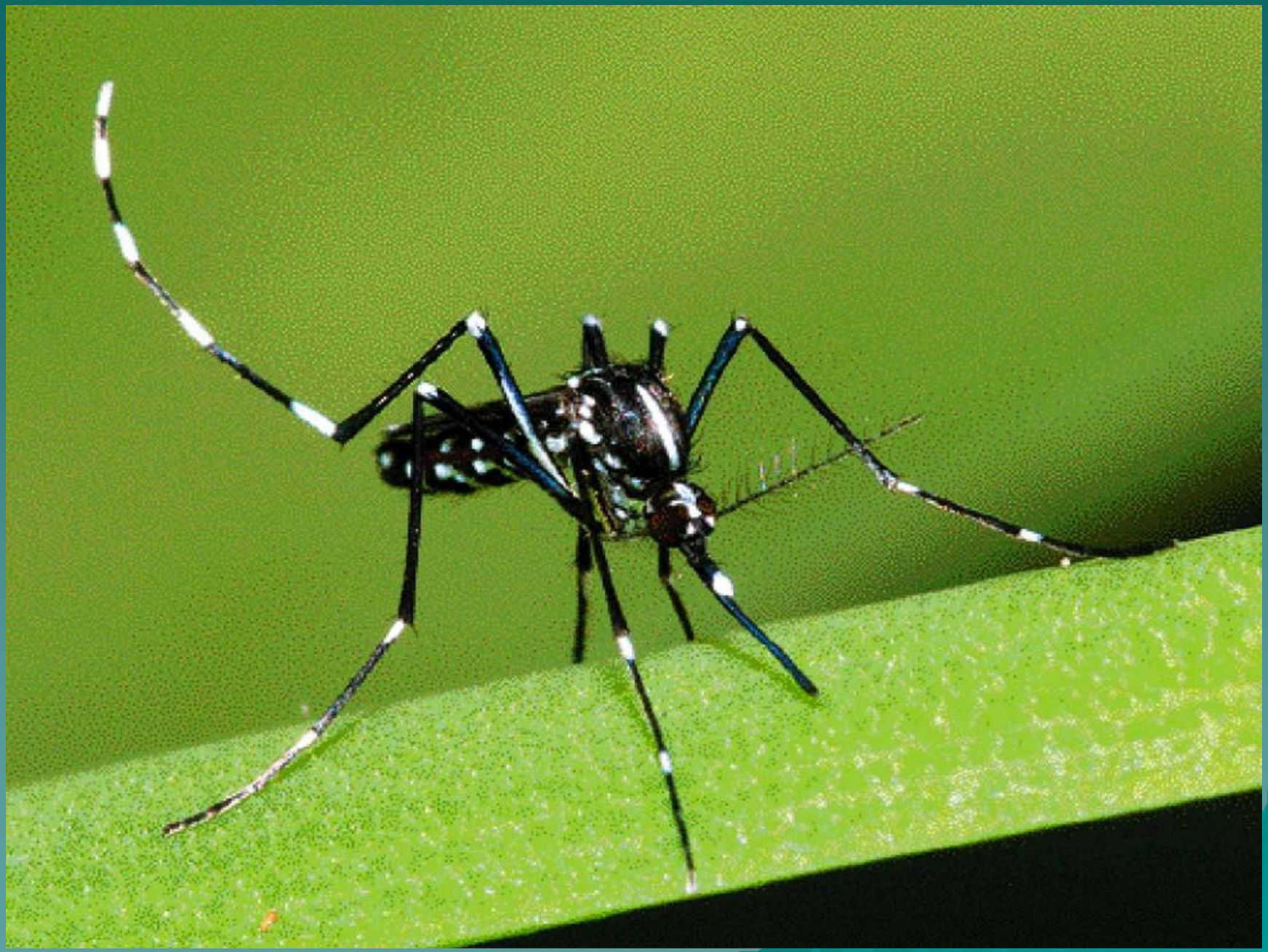
- Evidence of point mutation which altered a single amino acid in virus envelope protein
- Enhance infectivity of mosquito vectors – allowed virus to replicate easily in midgut
- 100-X increase in virus conc. in salivary glands of the mosquito.
- Possible increase in virulence as evidenced by ↑ severity & persistence of sx & ↑ proportion of fatal infections (1/1,000 cases).

A Tale of Two Mosquitoes



Aedes aegypti in the U.S., 2006 – Source C. Moore

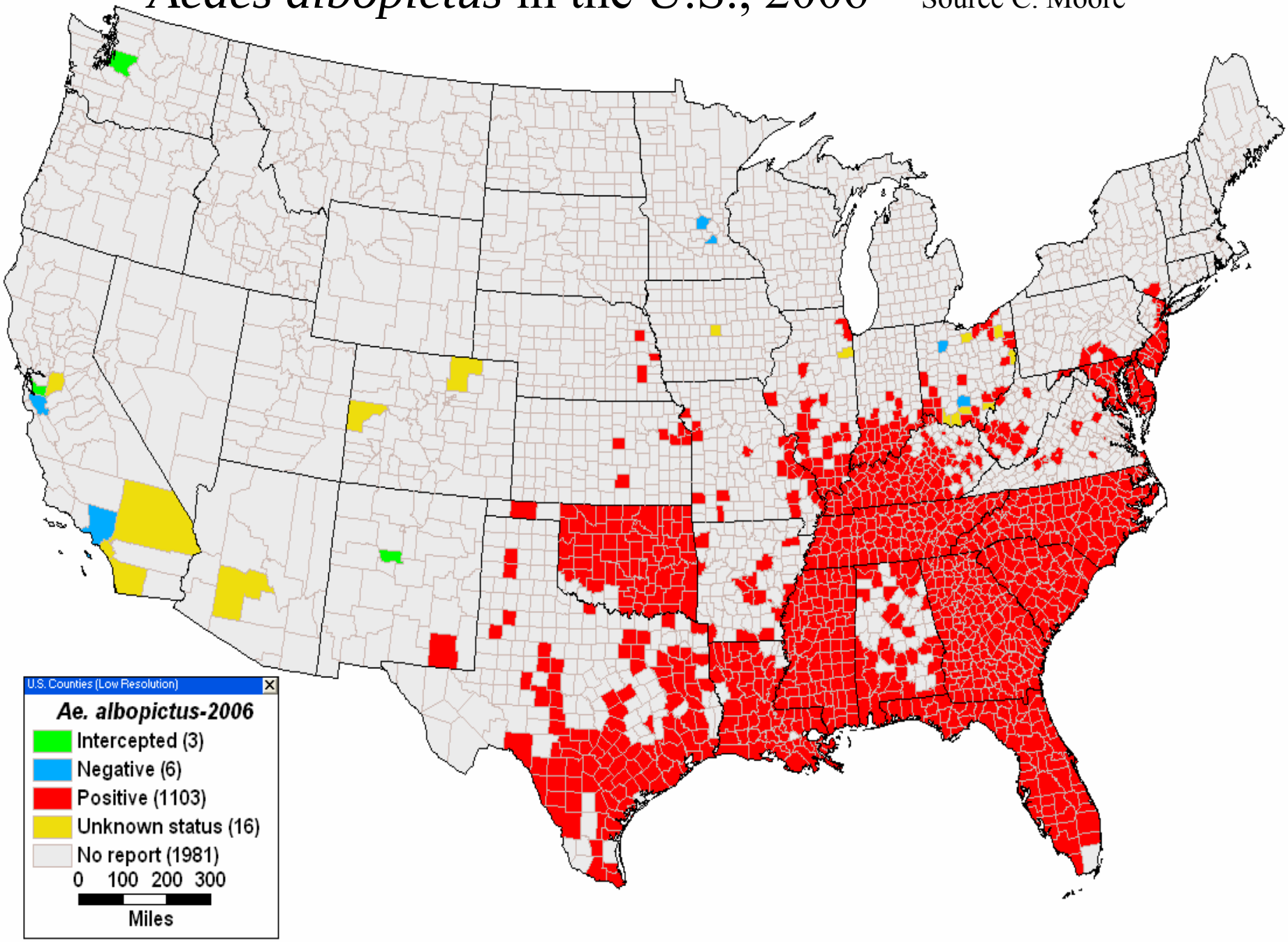




Diseases potentially vectored by *Aedes albopictus*

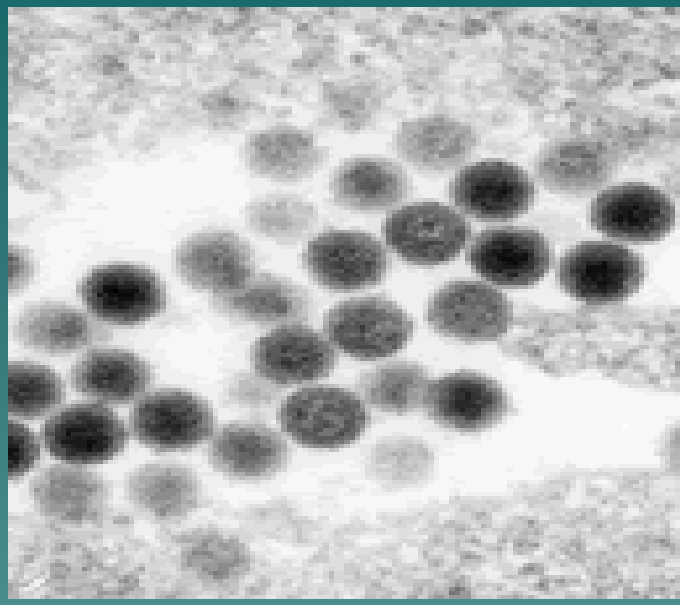
- Chikungunya
- Dengue 1,2,3,4
- Japanese Enc.
- Mayaro
- Orungo
- Potosi
- Rift Valley Fever
- Ross River
- San Angelo
- Sinbis
- VEE
- Yellow Fever

Aedes albopictus in the U.S., 2006 – Source C. Moore



Rift Valley Fever (RVF)

- Family *Bunyaviridae*
- Genus *Phlebovirus*
- First ID'ed in Kenya in 1930 as the cause of mortality & abortion in livestock
- Epizootics in animals occur after heavy rains & flooding which result in blooms of *Aedes* sp.
- Livestock morb./mort. precedes human outbreaks

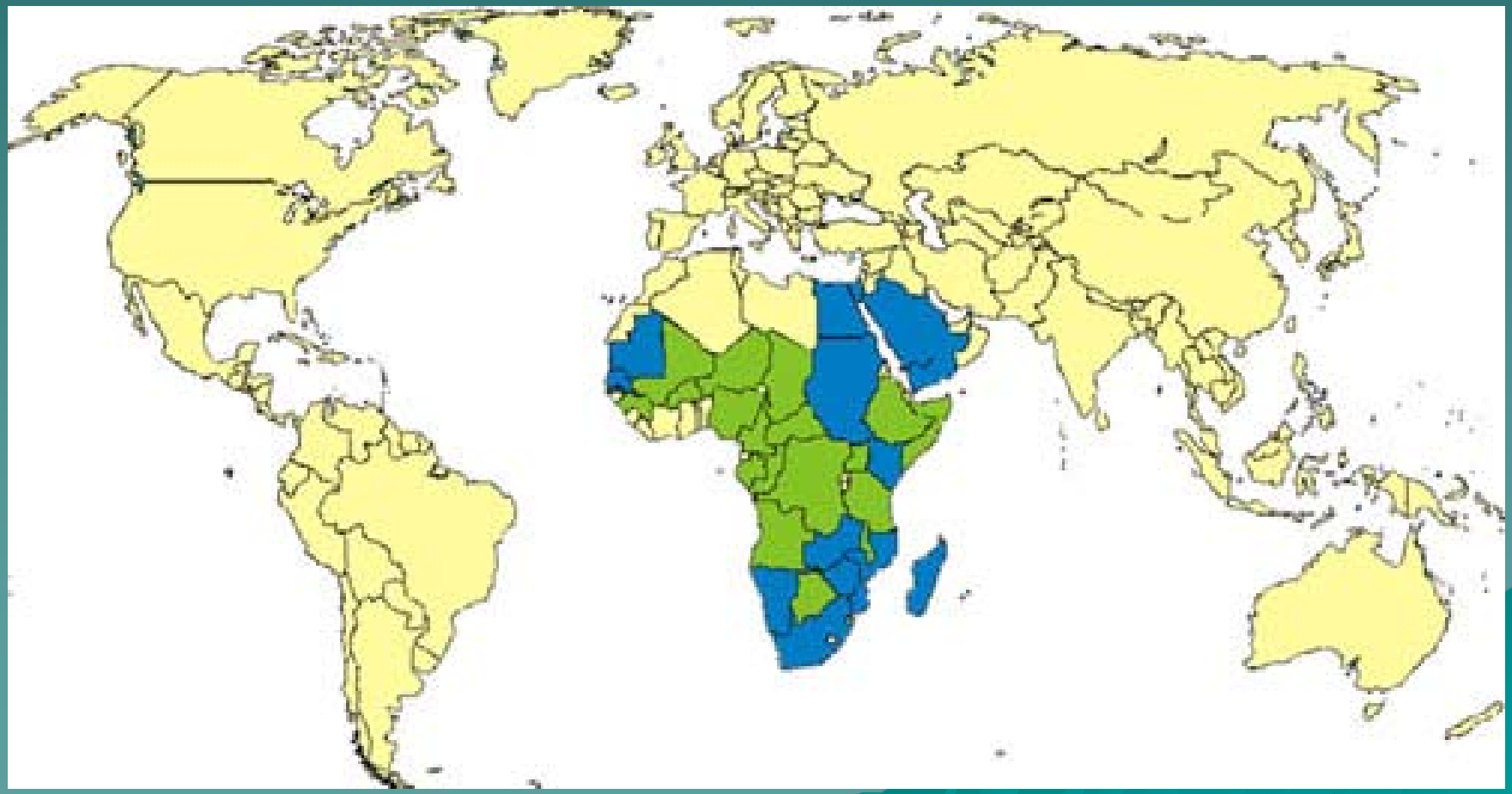


Rift Valley Fever (RVF)

- Reservoirs: livestock (cattle, sheep, goats, camels) – high viremias during infection.
- Human exposure usually occur through exposure to the infected livestock –esp. blood, tissues, fluids, aerosols.
- Occupational Risk: herding, milking, slaughtering/butchering, animal care, veterinary practice, farmers, etc.
- Consuming unpasteurized milk, etc.
- Mosquitoes (Anopheles, Mansonia, Aedes) can also transmit RVF to humans.
- RVF – primarily rural areas

Rift Valley Fever Map

- Blue = endemic regions
- Green = sporadic occurrence



RVF Symptoms

- Range of sx: asymptomatic – severe
- Mild: flu-like – sudden onset fever, HA, muscle pain, joint pain
- Some cases: meningitis-like w/ stiff neck, light sensitivity, appetite loss, vomiting
- Resolves w/in 4-7 days

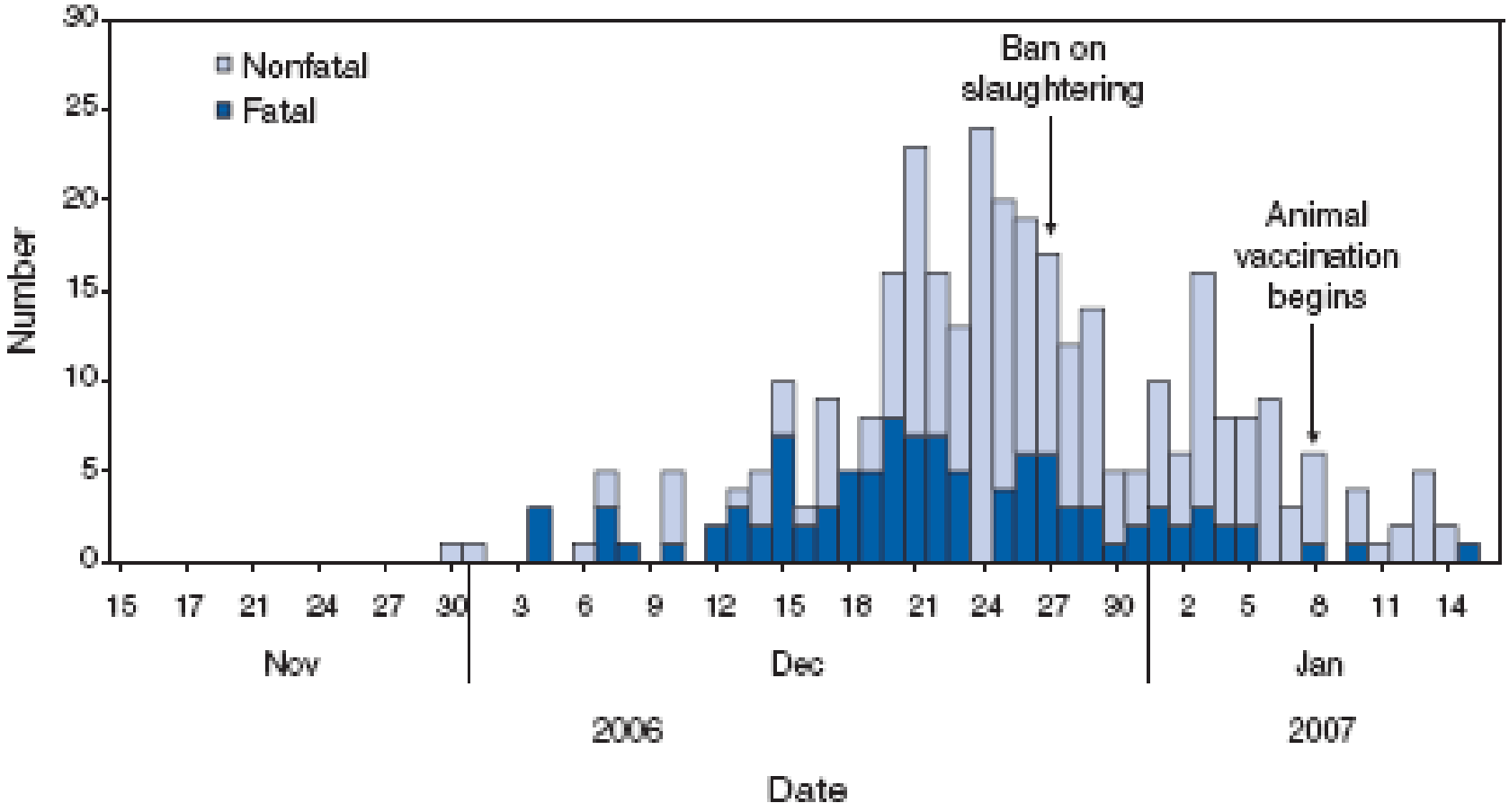
RVF Complications

- Ocular form: retinal lesions – blurred or decreases vision. Vision loss is usually not permanent.
- Meningoencephalitis: severe HA, memory loss, hallucinations, confusion, disorientation, vertigo, convulsions, lethargy, coma
- Hemorrhagic fever: liver disease, jaundice, vomiting blood, bloody stools, purpuric rash or eccymoses (bleeding in skin), bleeding from gums, nose, vagina

Significant RVF Outbreaks

- 1977-1978 – Egypt – 18,000 cases
- 1997-1998 – Kenya, Somalia, Tanzania – est. 89,000 human infections
- 2000 – Saudi Arabia – 800+/- cases
- 2000 – Yemen – 1,000 +/- cases
- 2006-2007 – Kenya Northeast Province – 400+ cases (118 deaths)
- Most recent 2008 – RVF in buffalo in Mpumalanga Region of South Africa

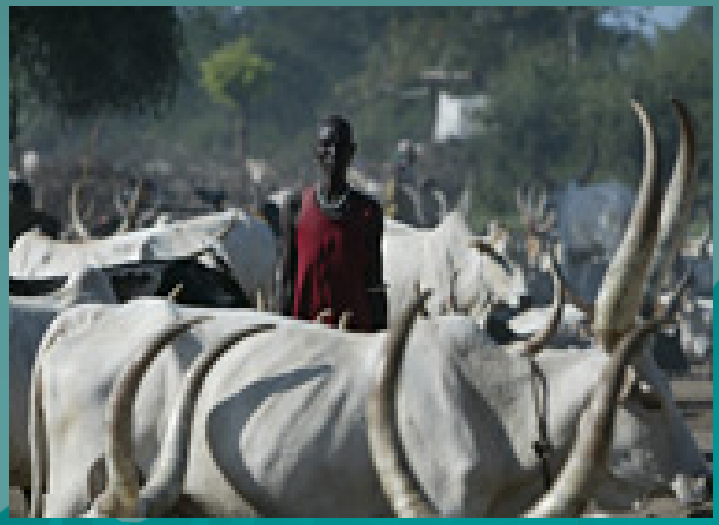
FIGURE 3. Number of reported Rift Valley fever cases (n = 330), by date of illness onset — Kenya November 2006–January 2007*



* As of January 25, 2007, for cases with known date of onset.

RVF Response

- Impose ban on slaughtering animals
- Ban on moving livestock
- Closure of livestock markets
- Livestock vaccination
- Prevention education
- Vector Control

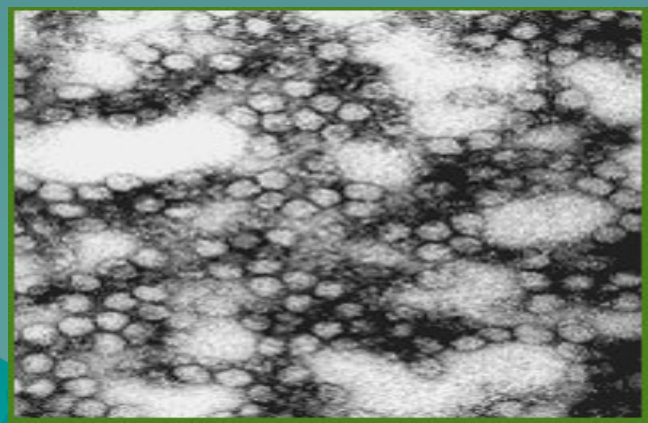


Yellow Fever (a.k.a. "Yellow Jack")

- Genus Flavivirus
- Virus / mosquito connection was made by C. Finlay & W. Reed – late 1800's
- Vectors: *Aedes aegypti, Ae. albopictus, Ae. sp., Haemagogus sp.*

◊Reservoirs:

- Sylvatic/"jungle" cycle -nonhuman primates (monkeys)
- Urban cycle - humans



Yellow Fever Symptoms

- *Range of illness: mild - severe*
- *Early Sx: Fever, chills, severe HA, back pain, muscle aches, fatigue, nausea, vomiting, weak/slow pulse*
- *Period of brief remission*
- *Toxic Phase: return of sx, plus stomach pain, jaundice, nose bleeds, gum bleeding, black vomit, purpuric hemorrhages*
- *Late Stage: hypotension, shock, metabolic acidosis, acute tublular necrosis, cardiac arrhythmias, confusion, seizures, coma*

Approximate Global Distribution of Yellow Fever, by State/Province, 2007

CDC

Yellow Fever - making a comeback

- Wide spread vaccination campaigns 1940-1960 virtually eradicated urban YF
- Vaccine campaigns stopped – new generation without immunity
- 1990's – YF has been on the rise
- 18 countries in Africa w/ cases since 2000
- Hardest hit region= West Africa
- WHO estimates 200,000 cases/year with 30,000 deaths

Yellow Fever in South America

- Most cases in S.A. have been "jungle" YF – rural areas
- 2008 ongoing YF outbreak in Paraguay – the first outbreak in 30+ years.
- 22 cases w/ 8 deaths - including rural & urban areas.
- Very serious concerns for rapid spread in poorer urban communities
- Paraguay has declared emergency

Yellow Fever in Paraguay

- YF outbreak has caused mass panic
- Mass vaccination campaigns underway w/ the 17D vaccine.
- More than 1.27 million doses given.
- Long lines at health facilities
- Local supplies of vaccine are being depleted.
- Neighboring countries, France & U.N. are delivering more vaccine.
- One case just reported in Argentina

And there are other arboviruses out there on the horizon…

- Japanese Encephalitis
- O'nyon-nyong
- Venezuelan Equine Encephalitis
- Murray Valley
- Usutu
- Kunjin
- Mayaro…….

The arbovirus of most immediate concern to Arizona

Dengue Fever